

Question Number	Answer	Acceptable answers	Mark
1(a)	<ul style="list-style-type: none"> <li>tin {<u>more</u> expensive/costs <u>more</u>} (than aluminium/steel) ORA (1)</li> <li>amount of tin in Earth <u>smaller</u> (than aluminium/steel) ORA (1)</li> </ul>	rarer	(2)

Question Number	Answer	Acceptable answers	Mark
1(b)	C - reduction		(1)

Question Number	Answer	Acceptable answers	Mark
1(c)(i)	an explanation linking the following <ul style="list-style-type: none"> <li>a mixture of (1)</li> <li>metals (1)</li> </ul>	reject compound ignore combined/joined  specific examples reject reference to non-metals  metals melted together (2)	(2)

Question Number	Answer	Acceptable answers	Mark
1(c)(ii)	<p>an explanation linking any <b>three</b> of</p> <ul style="list-style-type: none"> <li>• in pure metal /aluminium atoms are all same size (1)</li> <li>• in pure metal /aluminium { layers/sheets/atoms} { slide/slip/move} (over one another) easily(1)</li> <li>• magnesium atoms larger (1)</li> <li>• disrupt { layers/structure/arrangement} of aluminium atoms (1)</li> <li>• prevent { layers/sheets/atoms} { slip/slide/move} (1)</li> </ul>	<p>ions or particles for atoms reject molecules once only</p> <p>different sized particles</p> <p>{lock/hold/jam} layers together</p>	(3)

Question Number	Answer	Acceptable answers	Mark
<b>2(a)</b>	gold		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>2(b)</b>	{loss of / remove} oxygen	gain of electrons	<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>2(c)</b>	<p>An explanation linking</p> <p><b>either</b></p> <ul style="list-style-type: none"> <li>aluminium high(er) in reactivity / aluminium more reactive than carbon / aluminium compounds are very stable (1)</li> </ul> <p><b>or</b></p> <ul style="list-style-type: none"> <li>iron lower in reactivity / iron less reactive than carbon / iron compounds less stable (1)</li> </ul> <p><b>plus</b> one of</p> <ul style="list-style-type: none"> <li>(for aluminium) electrolysis is powerful means of reduction / needs powerful means of extraction / needs more energy (1)</li> <li>(for iron) can be reduced with {carbon / carbon monoxide} / use of carbon is cheaper / use of electricity is expensive / ORA (1)</li> </ul>	<p>stronger means of reduction</p> <p>can be reacted with {carbon / carbon monoxide} <b>and</b> oxygen removed</p>	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>2(d)</b>	<p>An explanation linking the following points</p> <ul style="list-style-type: none"> <li>(magnesium and aluminium) {atoms / ions / particles} are different sizes (1)</li> <li>this prevents the layers (of atoms / ions / particles) sliding over each other (1)</li> </ul>	<p>magnesium atoms are larger than aluminium atoms  <b>OR</b> aluminium atoms are larger than magnesium atoms</p> <p>sheets / rows</p> <p>penalise molecules only once</p>	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>2(e)</b>	$4 \text{ (Al) } + 3 \text{ (O}_2\text{ ) } \rightarrow \text{ (2Al}_2\text{O}_3\text{)}$ <p>4 (1) 3 (1)</p>		<b>(2)</b>

Question number	Answer	Mark
3(a)(i)	C	(1)

Question number	Answer	Mark
3(a)(ii)	C	(1)

Question number	Answer	Mark
3(b)	Any two of the following points. For the acid, use the same: <ul style="list-style-type: none"> <li>• volume (1)</li> <li>• concentration (1)</li> <li>• temperature (1)</li> </ul>	(2)

Question number	Answer	Mark
3(c)(i)	electrolysis (1)	(1)

Question number	Answer	Mark
3(c)(ii)	An answer that combines identification- knowledge (1 mark) and understanding (1 mark) and reasoning/justification- understanding (1 mark) <ul style="list-style-type: none"> <li>• aluminium compounds are more stable than iron compounds (1)</li> <li>• so carbon is not a strong enough reducing agent to produce aluminium from its ore (1)</li> </ul>	(2)

Question number	Answer	Mark
3(d)	$\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$ <ul style="list-style-type: none"> <li>• Correct formulae (1)</li> <li>• Balancing of correct formulae (1)</li> </ul>	(2)

Question Number	Answer	Acceptable answers	Mark
<b>4(a)</b>	loss of oxygen	gain of electrons	<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>4(b)</b>	<p>An explanation to include</p> <ul style="list-style-type: none"> <li>aluminium high in reactivity series / aluminium more reactive than {carbon / iron} (1)</li> <li>(aluminium reduction) needs more energy / electrolysis is {more / very} powerful (means of reduction) / carbon cannot displace aluminium (from aluminium oxide) (1)</li> </ul>	<p>aluminium compounds are stable aluminium is more reactive ignore just 'very reactive'/highly reactive</p> <p>allow stronger (method of reduction)</p>	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>4(c)</b>	$2\text{Fe}_2\text{O}_3 + 3\text{C} \rightarrow 4\text{Fe} + 3\text{CO}_2$ <p>(3)</p> <p>lhs (1) rhs (1) balancing correct formulae (1)</p>		<b>(3)</b>

Question Number	Indicative Content	Mark
<b>QWC</b>	<p data-bbox="306 288 421 323"><b>*4(d)</b></p> <p data-bbox="440 288 1209 323">A description including some of the following points</p> <p data-bbox="440 353 1369 428"><b>Property change (other than increased strength) or use of alloy</b></p> <ul data-bbox="440 432 1340 786" style="list-style-type: none"> <li>• increased hardness</li> <li>• decreased malleability</li> <li>• increased corrosion resistance</li> <li>• shape-memory</li> <li>• gold alloy for jewellery</li> <li>• stainless steel used for cutlery</li> <li>• steel used for construction</li> <li>• nitinol (shape-memory alloy) used for spectacle frames / stents</li> <li>• idea of any use of metal after alloying</li> </ul> <p data-bbox="440 821 740 856"><b>Structural change</b></p> <ul data-bbox="440 860 1385 1179" style="list-style-type: none"> <li>• pure metal – atoms are all the same size / suitable diagram of pure metal structure</li> <li>• atoms arranged in a regular way / lattice</li> <li>• alloy – atoms are of different sizes / suitable diagram of alloy structure</li> <li>• disrupts arrangement of atoms</li> <li>• atoms in pure metal structure can slide over each (when bent)</li> <li>• alloy – sliding prevented by different sized atoms</li> </ul>	<b>(6)</b>

<b>Level</b>	<b>0</b>	No rewardable content
<b>1</b>	<b>1 – 2</b>	<ul style="list-style-type: none"> <li>• a limited description of how one property changes, one use or one statement related to structure eg iron rusts, stainless steel does not; atoms in a pure metal all the same size</li> <li>• the answer communicates ideas using simple language and uses limited scientific terminology</li> <li>• spelling, punctuation and grammar are used with limited accuracy</li> </ul>
<b>2</b>	<b>3 – 4</b>	<ul style="list-style-type: none"> <li>• a simple description of how two properties change or two uses <b>or</b> a simple description of why alloys become stronger or a property/use and a statement about structure eg the atoms in a pure metal have a regular arrangement but in alloys there are different sized atoms</li> <li>• the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately</li> <li>• spelling, punctuation and grammar are used with some accuracy</li> </ul>
<b>3</b>	<b>5 – 6</b>	<ul style="list-style-type: none"> <li>• a detailed description of why alloys become stronger including at least one change in property of an alloy or use eg the atoms in a pure metal have a regular arrangement but in alloys the different sized atoms stops the atoms sliding over each other and how alloys are more useful such as gold alloys used in jewellery</li> <li>• the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately</li> <li>• spelling, punctuation and grammar are used with few errors</li> </ul>



Question Number	Answer	Acceptable answers	Mark
<b>5(a)</b>	<b>B</b> tin oxide is reduced		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>5(b) (i)</b>	<p>An explanation linking two of the following</p> <ul style="list-style-type: none"> <li>alloys have different sized atoms</li> <li>{ atoms/layers/sheets/particles} {slide/slip/move} over each other (easily) in pure metal</li> <li>{ structure/layers} disrupted (in alloy)</li> <li>stop { atoms/layers/sheets/particles} {sliding/slipping/moving} over one another (easily) in</li> </ul>	<p>suitable labelled diagrams</p> <p>reject molecules once</p>	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>5(b) (ii)</b>	all points plotted correctly (1) best fit line across 4 plotted points (1)	+/- 1 small square	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>5(b) (iii)</b>	Correct value from their graph +/- one small square (%)		<b>(1)</b>

Question Number	Indicative Content	Mark
<b>QWC</b>	<p><b>*5(c)</b></p> <p>An explanation including some of the following points</p> <p>gold</p> <ul style="list-style-type: none"> <li>• gold is an unreactive metal/at the bottom of the reactivity series</li> <li>• it does not combine with other elements in the Earth's crust</li> <li>• so is found as uncombined metal</li> <li>• cost of recovery is low</li> </ul> <p>iron</p> <ul style="list-style-type: none"> <li>• iron is a more reactive metal than gold and less reactive than aluminium/middle of reactivity series</li> <li>• found combined with other elements</li> <li>• it is extracted by heating with carbon</li> <li>• electrolysis can be used</li> <li>• but electrolysis is more expensive (than heating with carbon)</li> </ul> <p>aluminium</p> <ul style="list-style-type: none"> <li>• aluminium is a very reactive metal/near to top of the reactivity series</li> <li>• found combined with other elements</li> <li>• it is extracted by electrolysis</li> <li>• because it is very difficult to reduce</li> <li>• electrolysis is a powerful method of reduction</li> <li>• use of electricity makes this method expensive</li> </ul>	<b>(6)</b>
<b>Level</b>	No rewardable content	
<b>1</b>	<p><b>1 - 2</b></p> <ul style="list-style-type: none"> <li>• a limited description e.g. a simple justification in terms of reactivity or cost for how one of the metals is extracted OR an indication of how two of the metals are extracted</li> <li>• the answer communicates ideas using simple language and uses limited scientific terminology</li> <li>• spelling, punctuation and grammar are used with limited accuracy</li> </ul>	
<b>2</b>	<p><b>3 - 4</b></p> <ul style="list-style-type: none"> <li>• a simple description e.g. a simple indication of how all three metals are extracted OR an indication of how two of the metals are extracted with a justification in terms of reactivity or cost for one</li> <li>• the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately</li> <li>• spelling, punctuation and grammar are used with some accuracy</li> </ul>	
<b>3</b>	<p><b>5 - 6</b></p> <ul style="list-style-type: none"> <li>• a detailed description e.g. indicates how all three metals are extracted with a justification for at least two in terms of reactivity and a reference to cost</li> <li>• the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately</li> <li>• spelling, punctuation and grammar are used with few errors</li> </ul>	